# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-188235

(43)Date of publication of application : 10.07.2001

(51)Int.Cl. G02F 1/1339

(21)Application number : 11-375318

(22)Date of filing : 28.12.1999

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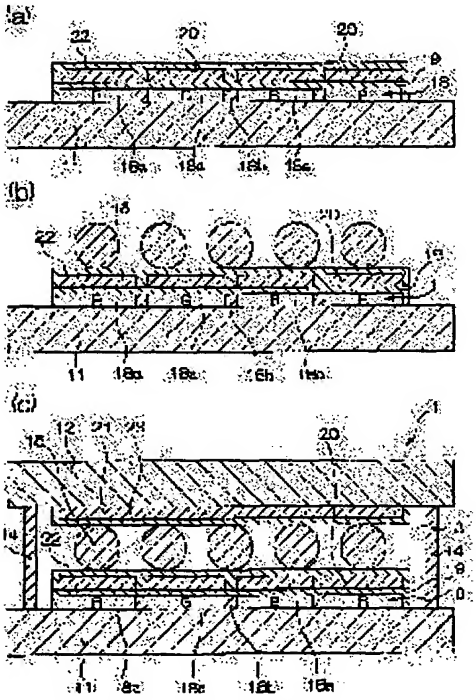
## (54) METHOD OF PRODUCING LIQUID CRYSTAL DEVICE, LIQUID CRYSTAL DEVICE AND ELECTRONIC APPLIANCE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method of producing a liquid crystal display device having excellent display quality by controlling the position and number of spacer particles to be sprayed, and to provide a liquid crystal display device.

SOLUTION: A spacer dispersion solution is prepared by uniformly dispersing spacer particles 15 in a specified concentration by ultrasonic or the like in a single solvent or a mixture solvent of two or more solvents selected from water, fluorocarbons, isopropyl alcohol, ethanol or the like, and the obtained dispersion solution is sprayed on a substrate 11. The spacer dispersion solution is sprayed onto a specified position of the substrate 11 in a specified amount by an ink jet method using an ink jet nozzle 30 in which the injection position and injection times of the liquid drips to be injected can be controlled as required. Then the solvent in the spacer dispersion solution is naturally vaporized to dispose the spacer particles 15 in a specified number on a specified position of the substrate 11. Thus, the spacer 15 can be sprayed in a uniform spray density in a specified region.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

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[Claim(s)]
[Claim 1] The manufacture method of the liquid-crystal equipment characterized by to sprinkle the aforementioned spacer by facing sprinkling many spacers for forming a predetermined interval between two substrates which pinch a liquid-crystal layer on one substrate, sprinkling only to the predetermined field which includes the pixel field on the aforementioned substrate for the spacer distribution solution which made the predetermined solvent distribute the aforementioned spacer with an ink-jet method, and evaporating this solvent.
[Claim 2] It is the manufacture method of the liquid crystal equipment which the coloring layer of the color from which the plurality for carrying out color display on one substrate differs is prepared, and is characterized by the aforementioned predetermined field being a field where the coloring layer of a predetermined color is formed among these coloring layers between two aforementioned substrates in the manufacture method of liquid crystal equipment according to claim 1.
[Claim 3] The manufacture method of the liquid crystal equipment characterized by the coloring layer of the aforementioned predetermined color being a coloring layer of red and blue in the manufacture method of liquid crystal equipment according to claim 2.
[Claim 4] It is the manufacture method of the liquid crystal equipment which the crevice is formed in one substrate front face between two aforementioned substrates, and is characterized by the aforementioned predetermined field being a field in which this crevice was formed in the manufacture method of liquid crystal equipment according to claim 1.
[Claim 5] The manufacture method of the liquid crystal equipment characterized by forming the level difference in one substrate front face between two aforementioned substrates, being small to Takabe and sprinkling the aforementioned large spacer of a different diameter in the low section in the manufacture method of liquid crystal equipment according to claim 1 according to the height on aforementioned one substrate.
[Claim 6] It is the manufacture method of the liquid crystal equipment characterized by thermoplastics being coated by the front face in the manufacture method of liquid crystal equipment given [ from a claim 1 to a claim 5 ] in any 1 term, as for the aforementioned spacer.
[Claim 7] Liquid crystal equipment characterized by being arranged in the liquid crystal equipment with which the spacer for forming a predetermined interval between two substrates which pinch a liquid crystal layer has been arranged by density uniform only to the predetermined field to which this spacer includes the pixel field of the whole substrate surfaces.
[Claim 8] It is liquid crystal equipment which the coloring layer of the color from which the plurality for carrying out color display on one substrate differs is prepared, and is characterized by the aforementioned predetermined field being a field where the coloring layer of a predetermined color is formed among these coloring layers between two aforementioned substrates in liquid crystal equipment according to claim 7.
[Claim 9] Liquid crystal equipment characterized by the coloring layer of the aforementioned predetermined color being a coloring layer of red and blue in liquid crystal equipment according to claim 8.
[Claim 10] It is the manufacture method of the liquid crystal equipment which the crevice is formed in one substrate front face between two aforementioned substrates, and is characterized by the aforementioned predetermined field being a field in which this crevice was formed in liquid crystal equipment according to claim 7.
[Claim 11] Liquid crystal equipment characterized by forming the level difference in one substrate front face between two aforementioned substrates, being small to Takabe and arranging the aforementioned large spacer of a different diameter in liquid crystal equipment according to claim 7 at the low section according to the height on aforementioned one substrate.
[Claim 12] It is liquid crystal equipment characterized by thermoplastics being coated by the front face in liquid crystal

equipment given [ from a claim 7 to a claim 11 ] in any 1 term, as for the aforementioned spacer.
[Claim 13] Electronic equipment characterized by having liquid crystal equipment given [ from a claim 7 to a claim 12 ] in any 1 term.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the liquid crystal equipment manufactured by the manufacture method of liquid crystal equipment, and this manufacture method, and electronic equipment equipped with this liquid crystal equipment, and relates to the technology which sprinkles a spacer on a substrate especially.
[0002]
[Description of the Prior Art] The outline cross section of the liquid crystal display 100 for the color displays common simple matrix type to drawing 9 is shown, and this structure is explained.
[0003] As shown in drawing 9 , a substrate 101 (bottom substrate) and the opposite substrate (top substrate) 102 are stuck at intervals of predetermined through a sealant 104 in the periphery section of each substrate, and the liquid crystal layer 103 is enclosed between the substrate 101 and the opposite substrate 102. On a substrate 101, the light-filter layer 108 which consists of coloring layer 108a and shading layer (black matrix) 108b of red (R), green (G), and blue (B), and a protective layer 109 are formed one by one, a transparent electrode 110 is formed in the shape of a stripe on a protective layer 109, and the transparent electrode 111 is formed in the shape of a stripe also on the opposite substrate 102. The orientation films 112 and 113 are formed on a transparent electrode 110 and 111.
[0004] In the liquid crystal display 100, between the orientation film 112 and 113, in order to make uniform the interval (substrate interval) of a substrate 101 and the opposite substrate 102, many spherical spacers 105 which consist of a silicon dioxide, polystyrene, etc. are arranged.
[0005] Conventionally as a method of sprinkling a spacer 105 on a transparent electrode 110 and the substrate 101 in which the orientation film 112 grade was formed The wet sprinkling method sprinkled by injecting the spacer distribution solution which distributed the spacer 105 to solvents, such as water, chlorofluocarbon, isopropyl alcohol, and ethanol, with the pressure of gas, such as air and nitrogen A spacer 105 is supplied by carrier gas, such as air and nitrogen, a spacer 105 is electrified automatically or intentionally in the middle of supply, and, generally the dry type sprinkling method make a spacer 105 adhere on a substrate 101 using the electrostatic force is learned.
[0006] The outline cross section of spraying equipment 200A of the wet sprinkling method and spraying equipment 200B of the dry type sprinkling method is shown in drawing 10 (a) and drawing 10 (b), respectively, and the structure of these spraying equipments and the sewage sprinkling of a spacer 105 are briefly explained to them. In drawing 10 (a) and drawing 10 (b), the same sign is given to the same component.
[0007] The spraying stage 201 which consists of stainless steel etc. is installed in the interior of the spraying equipments 200A and 200B, and the substrate 101 by which the transparent electrode 110 and the orientation film 112 grade were formed on the spraying stage 201 is installed. The atomiser 202 and the nozzle 203 are installed in the parietal region of the spraying equipments 200A and 200B.
[0008] In spraying equipment 200A of the wet sprinkling method, spacer supply pipe 204A and the compressed-gas supply pipe 205 are connected with the atomiser 202. Moreover, spacer supply pipe 204B is connected with the atomiser 202 in spraying equipment 200B of the dry type sprinkling method.
[0009] In the wet sprinkling method, as shown in drawing 10 (a), from spacer supply pipe 204A, the spacer distribution solution which distributed the spacer 105 to solvents, such as water, chlorofluocarbon, isopropyl alcohol, and ethanol, is supplied to an atomiser 202, and, on the other hand, compressed gas, such as air and nitrogen, is supplied to an atomiser 202 from the compressed-gas supply pipe 205. From a nozzle 203, the spacer 105 supplied to the atomiser 202 blows off, carries out free fall with a solvent and gas, and is sprinkled on a substrate 101.
[0010] In the dry type sprinkling method, as shown in drawing 10 (b), a spacer 105 is supplied to an atomiser 202 by making air, nitrogen, etc. into carrier gas from spacer supply pipe 204B. At this time, the spacer 105 is charged automatically or intentionally. From a nozzle 203, the spacer 105 supplied to the atomiser 202 blows off, carries out

free fall with carrier gas, and is sprinkled on a substrate 101. Since the spacer 105 is charged at this time, it can adhere on a substrate 101 by the electrostatic force.

[0011]

[Problem(s) to be Solved by the Invention] In the wet sprinkling method and the dry type sprinkling method which are a method of sprinkling the conventional spacer 105, in order to sprinkle by carrying out free fall of the spacer 105 on a substrate 101, there is a trouble that the position which sprinkles a spacer 105 is uncontrollable. Therefore, a problem which is indicated below has arisen.

[0012] In the above-mentioned common liquid crystal display 100, a spacer 105 condenses partially, the spraying density of a spacer 105 becomes uneven, and there is a trouble that a distribution arises at a substrate interval. About a problem when a distribution arises at a substrate interval, it mentions later.

[0013] Moreover, since the liquid crystal layer 103 is not formed in the place where the spacer 105 was sprinkled, the portion cannot be displayed black, but light leaks from there, and there is a trouble that contrast falls. Especially this problem is remarkable when a spacer 105 is sprinkled among coloring layer 108a of the light-filter layer 108 by the range of green (G) coloring layer 108a.

[0014] Moreover, since the light-filter layer 108, a transparent electrode 110, etc. are formed on a substrate 101, a level difference may be formed in the front face of a substrate 101, and Takabe and the low section may be formed bordering on a level difference. When a spacer 105 is sprinkled by both Takabe of the front face of a substrate 101, and the low section, the trouble that a distribution arises is in a substrate interval. About a problem when a distribution arises at a substrate interval, it mentions later.

[0015] Here, a level difference is formed in the front face of a bottom substrate, and the example which a distribution produces at a substrate interval is explained.

[0016] The example by which a level difference is formed in the front face of a substrate 101 at drawing 11 in the liquid crystal display 300 for simple matrix type color displays is shown. In drawing 11 , the same sign is given to the same component as a liquid crystal display 100, and explanation is omitted.

[0017] In a liquid crystal display 300, a viewing area is set to 150 and a non-display field is set to 151. Usually, the non-display field 151 and the inside [ it ] serve as [ 1-2mm ] a viewing area 150 from the inside of a sealant 104. In the liquid crystal display 300, the light-filter layer 108, a protective layer 109, transparent electrodes 110 and 111, and the orientation films 112 and 113 are formed only in a viewing area 150, and are not formed in the non-display field 151.

[0018] In a liquid crystal display 300, since the light-filter layer 108, a protective layer 109, transparent electrodes 110 and 111, and the orientation films 112 and 113 are formed only in a viewing area 150 and formed in the non-display field 151, a level difference is formed in the boundary portions of a viewing area 150 and the non-display field 151 in the front face of a substrate 101. That is, the front face of the substrate 101 in a viewing area 150 is formed in the position higher than the front face of the substrate 101 in the non-display field 151.

[0019] For example, in the thickness (cell **) of the liquid crystal layer [ in / 2-3 [mum], and a viewing area 150 / in the height (thickness from the light-filter layer 108 to the orientation film 112) of the level difference formed in the front face of a substrate 101 ] 103, and the diameter of a spacer 105, the interval (substrate interval) of 5 [mum], a substrate 101, and the opposite substrate 102 is 7-8 [mum].

[0020] Since the thickness (cell **) of the liquid crystal layer [ in / the non-display field 151 / at this time ] 103 is the same as a substrate interval, it is 7-8 [mum]. however, the non-display field 151 -- setting -- a cell -- thick, since the spacer 105 of 5 [mum] is sprinkled at the place of 7-8 [mum] As a result of being unable to maintain cell ** of 7-8 [mum], but the interval (substrate interval) of a substrate 101 and the opposite substrate 102 becoming narrow and distortion arising in a substrate 101 and the opposite substrate 102, distribution that it is narrow and a core is large produces the periphery section at the substrate interval of a viewing area 150.

[0021] Next, a level difference is formed in the front face of a bottom substrate, and another example which a distribution generates at a substrate interval is explained.

[0022] Outdoor daylight, such as sunlight and lighting light, is used without building in the light source, the outdoor daylight which carried out incidence from the outside (observer side) of a liquid crystal display is reflected by the reflecting layer prepared in the interior of a liquid crystal display, and the reflected type liquid crystal display emitted to the exterior (observer side) of a liquid crystal display is known. In the reflected type liquid crystal display, while forming much detailed irregularity on the surface of a reflecting layer and reflecting light, the reflected type liquid crystal display of the internal dispersion method which can obtain a bright display is known by making it scattered about.

[0023] The outline cross section of the reflected type liquid crystal display 400 of an internal dispersion method is shown in drawing 12 . In drawing 12 , the same sign is given to the same component as a liquid crystal display 100, and explanation is omitted.

[0024] In the reflected type liquid crystal display 400 of an internal dispersion method, much detailed irregularity is formed in substrate (bottom substrate) 401 front face, and the reflecting layer 406 which has much detailed irregularity is formed on a substrate 401 by carrying out sputtering of the metals, such as aluminum, along with detailed irregularity.
[0025] An insulating layer 407 is formed on a reflecting layer 406, and the light-filter layer 108 and the transparent-electrode 110 grade are formed like the liquid crystal display 100 on the insulating layer 407.
[0026] When a substrate 401 is a glass substrate, the irregularity with substrate 401 detailed front face is formed of the frosting processing which **********s the front face of a glass substrate unevenly with a fluoric acid solution etc. Moreover, in the case of a substrate with a substrate 401 not only a glass substrate but general, the irregularity with substrate 401 detailed front face is formed by spraying a particle on the surface of a substrate of the sandblasting processing which makes a front face uneven.
[0027] In the liquid crystal display 400, the detailed irregularity formed in substrate 401 front face is formed only in the viewing area 150. On the other hand, a reflecting layer 406, an insulating layer 407, the light-filter layer 108, a protective layer 109, transparent electrodes 110 and 111, and the orientation films 112 and 113 are formed not only in the viewing area 150 but in the non-display field 151.
[0028] Although the irregularity with substrate 401 detailed front face is formed of frosting processing or sandblasting processing, detailed irregularity is formed by deleting the substrate 401 original front face also in processing [ which ]. Therefore, in substrate 401 front face, as drawing 12 shows, a level difference is formed and this level difference serves as 1 [mum] grade on the boundary of the portion in which detailed irregularity is formed, and the flat portion which is not formed, i.e., the boundary of a viewing area 150 and the non-display field 151. Moreover, a level difference will be formed in the reflecting layer 406 formed on it, the light-filter layer 108, the orientation film 112, etc. if a level difference is formed in substrate 401 front face.
[0029] Consequently, the front face of the substrate 401 in a viewing area 150 is formed in a position lower than the front face of the substrate 401 in the non-display field 151.
[0030] for example, the spacer 105 which will be sprinkled by the non-display field 151 if the spacer 105 of 5 [mum] is sprinkled in order to equalize this cell ** when the thickness (cell **) of the liquid crystal layer 103 in a viewing area 150 is set up with 5 [mum] -- a viewing area 150 -- 1 [mum] grade for height of a level difference -- it is sprinkled by the high position consequently, the cell to which the thickness (cell **) of the liquid crystal layer 103 in a viewing area 150 was set with 6 [mum] grades -- thick -- since it becomes thicker than 5 [mum], an indication as a design will be given
[0031] Furthermore, in a viewing area 150, since the spacer 105 of 5 [mum] is sprinkled at the place of cell ** about 6 [mum], as a result of being unable to maintain cell ** which is 6 [mum] grades, but the interval (substrate interval) of a substrate 101 and the opposite substrate 102 becoming narrow and distortion arising in a substrate 101 and the opposite substrate 102, a distribution arises at a substrate interval.
[0032] Here, a problem when a distribution arises at a substrate interval is explained. If a distribution arises at a substrate interval, a distribution will arise also in the thickness (cell **) of the liquid crystal layer pinched in the meantime. If a distribution arises in cell ** in a viewing area, it is known in the liquid crystal display that a display performance will get worse.
[0033] especially in the liquid crystal display in STN (Super Twisted Nematic) mode, that the permeability of light changes with change of deltan-d value (however, deltan the rate of a birefringence of liquid crystal and d cell **) knows -- having -- **** -- deltan-d value change, i.e., a cell, -- thick -- since a distribution will occur in a light transmittance, i.e., a luminosity, if the distribution of d is large, contrast falls moreover, deltan-d value change, i.e., a cell, -- thick -- if the distribution of d is large, although losing peculiar yellow and blue coloring with a phase contrast board, and compensating black and white in STN mode will be performed, at this time, an optical property will get worse and an irregular color will arise in a display moreover, a cell -- thick -- if d has a distribution, the steep nature of liquid crystal will get worse and contrast will fall thus, a cell -- thick -- since contrast gets worse and an irregular color occurs in a display when a distribution arises in d, there is a problem that display quality deteriorates
[0034] Then, it aims at offering the manufacture method of the liquid crystal equipment which enables equalization of a substrate interval by this invention's solving the above-mentioned trouble and controlling the position which sprinkles a spacer. Moreover, it aims at offering the manufacture method of a liquid crystal display that a spacer is not sprinkled in the field in which a green (G) coloring layer is formed by controlling the position which sprinkles a spacer.

[0035] Moreover, it aims at offering the liquid crystal display which was excellent in display quality, and electronic equipment equipped with this liquid crystal display by these manufacture methods.
[0036]

[Means for Solving the Problem] The means which this invention provided in order to solve the above-mentioned technical problem The spacer distribution solution which it faced [ solution ] sprinkling many spacers for forming a predetermined interval between two substrates which pinch a liquid crystal layer on one substrate, and made the predetermined solvent distribute the aforementioned spacer with an ink-jet method It is characterized by sprinkling the aforementioned spacer by sprinkling only to a predetermined field including the pixel field on the aforementioned substrate, and evaporating this solvent.

[0037] According to this means, the manufacture method of the position of the spacer sprinkled on a substrate and the liquid crystal equipment which can control the number can be offered by sprinkling a spacer with the ink-jet method using the ink-jet nozzle which the **** position and the number of times of **** of a drop which are breathed out can set up arbitrarily.

[0038] Moreover, in the liquid crystal equipment with which the spacer for forming a predetermined interval by this manufacture method between two substrates which pinch a liquid crystal layer has been arranged, the liquid crystal equipment characterized by being arranged by density uniform only to the predetermined field to which this spacer includes a pixel field among the whole substrate surfaces can be offered. Since the spacer is arranged by density uniform to a predetermined field, this liquid crystal equipment turns into liquid crystal equipment with which the substrate interval was equalized and which was excellent in display quality.

[0039] When the coloring layer from which the plurality for carrying out color display differs is prepared on one substrate between two aforementioned substrates, the aforementioned predetermined field is characterized by being the field in which the coloring layer of a predetermined color is formed among these coloring layers. As for the coloring layer of the aforementioned predetermined color, it is desirable that it is the coloring layer of red and blue.

[0040] In this case, since a spacer is not sprinkled by the field in which a green coloring layer is formed, optical leakage can be prevented and the manufacture method of liquid crystal equipment and liquid crystal equipment which were excellent in the good display quality of contrast can be offered.

[0041] Moreover, when the crevice is formed in one substrate front face between two aforementioned substrates, the aforementioned predetermined field is characterized by being the field in which this crevice was formed.

[0042] In this case, although the portion in which the crevice is formed in the substrate front face is located in a place lower than the portion of the flat field in which the crevice is not formed, by sprinkling a spacer only into the portion in which the crevice is formed, a substrate interval can be equalized and the manufacture method of liquid crystal equipment and liquid crystal equipment which were excellent in display quality can be offered.

[0043] Moreover, when the level difference is formed in one substrate front face between two aforementioned substrates, according to the height on aforementioned one substrate, to Takabe, it is small and is characterized by sprinkling the aforementioned large spacer of a different diameter at the low section.

[0044] In this case, according to the height on a substrate, to Takabe on a substrate, it is small, and by sprinkling the large spacer of a different diameter in the low section, a substrate interval can be equalized and the manufacture method of liquid crystal equipment and liquid crystal equipment which were excellent in display quality can be offered.

[0045] Moreover, as for the aforementioned spacer, in the above means, it is desirable to coat a front face with thermoplastics. The spacer sprinkled by the position is fixable on a substrate by warming the spacer sprinkled on the substrate by using as a spacer that by which the front face was coated with thermoplastics, lowering to ordinary temperature again and solidifying thermoplastics, after fusing the thermoplastics with which the front face was coated.

[0046] Moreover, the electronic equipment which was excellent in display quality can be offered by having liquid crystal equipment offered by the above means.

[0047]

[Embodiments of the Invention] Next, the operation form concerning this invention is explained in detail.

[0048] Process drawing showing the manufacture method of the liquid crystal display 1 for the simple matrix type color displays of the 1st operation form concerning this invention is shown in 1st operation form drawing 1 , and the manufacture method of this liquid crystal display and structure are explained to it.

[0049] As shown in drawing 1 (a), the light-filter layer 18 which consists of coloring layer 18a and shading layer (black matrix) 18b, and the protective layer 19 which protects the light-filter layer 18 are formed one by one on the substrate (bottom substrate) 11 which consists of glass etc., a transparent electrode 20 is formed in the shape of a stripe on a protective layer 19, and the orientation film 22 is formed on a transparent electrode 20.

[0050] Coloring layer 18a was formed of a coloring sensitized material method, a staining technique, a replica method, print processes, etc., for example, three colors of red (R), green (G), and blue (B) have arranged it by the predetermined pattern. Moreover, shading layer (black matrix) 18b is formed in the part in which coloring layer 18a is not formed, and consists of metals, such as chromium, a color resist which distributed black pigment.

[0051] Next, as shown in drawing 1 (b), many spherical spacers 15 which consist of a silicon dioxide, polystyrene, etc. for making a substrate interval uniform on the orientation film 22 are sprinkled. At this time, a spacer 15 is sprinkled with the ink-jet method learned for an ink jet printer etc. using the ink-jet nozzle 30 as shown in drawing 2 and drawing 3 . The diameter of a spacer 15 is set up according to the thickness (cell **) of the liquid crystal layer 13 enclosed with a liquid crystal display 1, for example, is chosen from within the limits of 2-10 [mum]. About the detail of the sewage sprinkling of a spacer 15, it mentions later.

[0052] Next, as shown in drawing 1 (c), a substrate 11 and the opposite substrate (top substrate) 12 which formed the transparent electrode 21 in the shape of a stripe on the front face, and formed the orientation film 23 on the transparent electrode 21 are stuck through a sealant 14 so that the orientation films 22 and 23 may counter, and the liquid crystal layer 13 is enclosed between a substrate 11 and the opposite substrate 12. Although finally omitted by illustration, a polarizing plate, a phase contrast board, etc. are attached on the outside surface of a substrate 11 and the opposite substrate 12, and a liquid crystal display 1 is created.

[0053] Here, the sewage sprinkling of the spacer 15 to a substrate 11 top is explained. In this operation form, the spacer distribution solution which distributed the spacer 15 uniformly by predetermined concentration according to the ultrasonic wave etc. to the single solvent or two or more sorts of single mixed solvents which are chosen from water, chlorofluocarbon, isopropyl alcohol, ethanol, etc. is sprinkled on a substrate 11. At this time, the spacer distribution solution of a predetermined amount is sprinkled to the position on a substrate 11 by using drawing 2 and the ink-jet nozzle 30 as show drawing 3 which can set up arbitrarily the **** position and the number of times of **** of a drop which are breathed out. Then, the spacer 15 of the predetermined number is arranged to the position on a substrate 11 by evaporating the solvent of a spacer distribution solution automatically.

[0054] In this operation form, it is desirable to use the adhesion spacer with which the front face was coated with thermoplastics as a spacer 15. In using an adhesion spacer as a spacer 15, after sprinkling a spacer 15 on a substrate 11 and evaporating a solvent, by warming the substrate 11 which sprinkled the spacer 15 at about 100 degrees C, the thermoplastics with which the front face of a spacer 15 was coated is fused, and the fused resin is solidified by lowering temperature to ordinary temperature again. Since a spacer 15 is fixable on a substrate 11 at this time, even if time passes, the position of the spacer 15 sprinkled to the position does not change.

[0055] Next, the structure of the ink-jet nozzle 30 which is an example of the ink-jet nozzle used with this operation form is explained. Drawing 2 and drawing 3 show the perspective diagram of the ink-jet nozzle 30, and the cross section, respectively.

[0056] The ink-jet nozzle 30 is equipped with the nozzle plate 31 and diaphragm 32 made from stainless steel as shown in drawing 2 , and both are joined through the batch member (reservoir plate) 33. between a nozzle plate 31 and diaphragms 32 -- a batch -- two or more space 34 and liquid reservoirs 35 are formed of the member 33 The spacer distribution solution is filled and each space 34 and the liquid reservoir 35 are opening the interior of each space 34 and a liquid reservoir 35 for free passage through a feed hopper 36. furthermore, the nozzle for injecting a spacer distribution solution from space 34 to a nozzle plate 31 -- the hole 37 is formed On the other hand, the hole 38 for supplying a spacer distribution solution to a liquid reservoir 35 is formed in the diaphragm 32.

[0057] Moreover, as shown in drawing 3 , the piezoelectric device 39 is joined on the field which counters the space 34 of a diaphragm 32, and the field of an opposite side. This piezoelectric device 39 is located between the electrodes 40 of a couple, and if it energizes, it will bend so that a piezoelectric device 39 may project outside, and the diaphragm 32 to which the piezoelectric device 39 is joined simultaneously will also be united, and it will bend outside. The capacity of space 34 increases by this. Therefore, the spacer distribution solution equivalent to a part for the capacity which increased in space 34 flows through a feed hopper 36 from a liquid reservoir 35. Next, if the energization to a piezoelectric device 39 is canceled, both a piezoelectric device 39 and the diaphragm 32 will return to the original configuration. since space 34 also returns to the original capacity by this -- the pressure of the spacer distribution solution of the space 34 interior -- going up -- a nozzle -- the drop 41 of a spacer distribution solution is breathed out towards a substrate from a hole 37

[0058] Next, in a liquid crystal display 1, the plan when seeing the light-filter layer 18 from the upper part is expanded and shown in drawing 4 and drawing 5 , and the spraying position of a spacer 15 and the example of the spraying number are explained to them. Although the transparent electrode 20 and the orientation film 22 grade are formed on the light-filter layer 18, it is omitting in illustration.

[0059] In a liquid crystal display 1, one coloring layer 18a is formed corresponding to the field where one transparent electrode 20 and one transparent electrode 21 cross, and the one range of coloring layer 18a is called sub pixel. Moreover, it becomes 1 pixel by three coloring layer 18a which consists of red (R), green (G), and blue (B), and one display is attained.

[0060] Generally, as spraying density of a spacer 15, 70 [individual / mm2] grades are needed. For example, since

there is [ a viewing area which is an example of the liquid crystal panel carried in a notebook sized personal computer / the vertical 192[mm] x width 144 [mm] and the pixel pitch P ] a sub pixel of 640x3(R, G, B) x480 (=921,600) individual in the liquid crystal panel of 0.3 [mm], it is required for the sub pixel of a piece to sprinkle about two spacers 15.

[0061] Therefore, as shown in drawing 4 , about two spacers 15 should just be sprinkled in the sub pixel of **** 0.3 [mm] x horizontal abbreviation 0.1 [mm].

[0062] For example, since 1 dot of drops 41 of about 17.6 [mum] can be struck when the ink-jet nozzle 30 of resolution 1440dpi (dot per inch) is used, the diameter of a spacer 15 is 1-4. What is necessary is to adjust the concentration of a spacer distribution solution and just to sprinkle one drop at a time for every sub pixel as two spacers 15 are distributed by one drop when it is [mum]. Or the concentration of a spacer distribution solution may be adjusted as one spacer 15 is distributed by one drop, and you may sprinkle two drops at a time for every sub pixel. Moreover, the diameter of a spacer 15 is 4-10. What is necessary is to adjust the concentration of a spacer distribution solution and just to sprinkle two drops at a time for every sub pixel as one spacer 15 is distributed by one drop when it is [mum].

[0063] Here, although the ink-jet nozzle 30 of resolution 1440dpi was explained, this invention chooses the ink-jet nozzle 30 which carries out the regurgitation of the drop of a suitable size according to the diameter of not only this but the spacer 15, and should just sprinkle about two spacers 15 for every sub pixel.

[0064] In this operation form, although the example which sprinkles the spacer 15 of the predetermined number for every sub pixel was shown, this invention can equalize the spraying density of a spacer 15 by sprinkling the spacer 15 of the predetermined number to the position not only this but on a substrate 11. Moreover, in this operation form, although only the liquid crystal display for color displays was explained, this invention is applicable not only to this but the liquid crystal display for monochrome display.

[0065] Moreover, although it said previously that optical leakage arises and contrast falls when the spacer 15 was sprinkled by the range of green (G) coloring layer 18a According to this operation form, by sprinkling a spacer 15 with the ink-jet method using the ink-jet nozzle 30 As shown in drawing 5 , it is also possible to sprinkle a spacer 15 only in the range of blue (B) coloring layer 18a with red (R), and not to sprinkle a spacer 15 in the range of green (G) coloring layer 18a.

[0066] Thus, according to this operation form, by sprinkling a spacer 15 with the ink-jet method using the ink-jet nozzle 30, the spraying position of a spacer 15 and the spraying number can be controlled, and the manufacture method of a liquid crystal display that the spraying density of a spacer 15 was equalized can be offered. Moreover, while the spraying density of a spacer 15 is equalized and a substrate interval is equalized by this manufacture method, the liquid crystal display which was excellent in the display quality which suppressed the optical leakage by condensation of a spacer can be offered.

[0067] Moreover, by sprinkling a spacer 15 with an ink-jet method, a spacer 15 can be sprinkled only in the range of blue (B) coloring layer 18a with red (R), and the range of green (G) coloring layer 18a can be provided with the manufacture method of a liquid crystal display which does not sprinkle a spacer 15. Moreover, by this manufacture method, the optical leakage by which the spacer 15 has been arranged only at the range of coloring layer 18a of red (R) and blue (B) can be prevented, and the liquid crystal display which was excellent in the good display quality of contrast can be offered.

[0068] The outline cross section of the liquid crystal display 2 for the simple matrix type color displays of the 2nd operation form concerning this invention is shown in 2nd operation form drawing 6 , and the structure and the manufacture method of this liquid crystal display are explained to it. In drawing 6 , the same sign is given to the same component as a liquid crystal display 1, and explanation is omitted.

[0069] In the liquid crystal display 2, the non-display field 51 and the inside [ it ] serve as [ 1-2mm ] a viewing area 50 from the inside of a sealant 14.

[0070] In the liquid crystal display 2, the light-filter layer 18, a protective layer 19, transparent electrodes 20 and 21, and the orientation films 22 and 23 are formed only in a viewing area 50, and are not formed in the non-display field 51.

[0071] In the liquid crystal display 2, since the light-filter layer 18, a protective layer 19, transparent electrodes 20 and 21, and the orientation films 22 and 23 are formed only in a viewing area 50 and it is not formed in the non-display field 51, the level difference is formed in the boundary portions of a viewing area 50 and the non-display field 51 in the front face of a substrate 11. That is, the front face of the substrate 11 in a viewing area 50 is formed in the position higher than the front face of the substrate 11 in the non-display field 51.

[0072] In this operation gestalt, the spacers 25A and 25B of a different diameter bordering on a level difference are arranged between the substrate 11 and the opposite substrate 12 according to the thickness (cell **) of the liquid crystal layer 13. That is, spacer 25A with the small diameter doubled with the thickness (cell **) of the liquid crystal layer 13

in a viewing area 50 is arranged at a viewing area 50, and spacer 25B with the large diameter doubled with the thickness (cell **) of the liquid crystal layer 13 in the non-display field 51 is arranged in the non-display field 51.
[0073] For example, when the height (thickness from the light-filter layer 18 to the orientation film 22) of the level difference by which the diameter of cell ** in a viewing area 50 and spacer 25A is formed in the front face of 5 [mum] and a substrate 11 is 2-3 [mum] grade, cell ** in the interval (substrate interval) 51, i.e., the non-display field, of a substrate 11 and the opposite substrate 12 serves as 7-8 [mum] grade. Therefore, in the non-display field 51, spacer 25B about [ of the non-display field 51 ] the cell thick diameters 7-8 doubled with 7-8 [mum] [mum] is arranged.
[0074] Here, how to sprinkle two kinds of spacers 25A and 25B on a substrate 11 is explained. The spacer distribution solution A which distributed spacer 25A uniformly by predetermined concentration according to the ultrasonic wave etc. to the single solvent or two or more sorts of single mixed solvents which are chosen from water, chlorofluocarbon, isopropyl alcohol, ethanol, etc. is produced. The spacer distribution solution B is similarly produced about spacer 25B.
[0075] In the viewing area 50 on a substrate 11, as the 1st operation gestalt explained, the distributed solution A of spacer 25A is uniformly sprinkled using the ink-jet nozzle 30. Moreover, in the non-display field 51 on a substrate 11, the distributed solution B of spacer 25B is uniformly sprinkled using another ink-jet nozzle 30.
[0076] In this operation gestalt, it is desirable to use the adhesion spacer with which the front face was coated with thermoplastics as spacers 25A and 25B. As the 1st operation gestalt explained, the sprinkled spacers 25A and 25B are fixable on a substrate 11 by using an adhesion spacer as spacers 25A and 25B.
[0077] Since it becomes possible to control the position which sprinkles a spacer by sprinkling a spacer with the ink-jet method using the ink-jet nozzle 30 according to this operation gestalt, When height is formed in the front face of a substrate 11 According to the thickness (cell **) of the liquid crystal layer 13, Takabe can sprinkle spacer 25A with a small diameter, spacer 25B with a large diameter can be sprinkled in the low section, and the manufacture method of a liquid crystal display that the substrate interval was equalized can be offered. Moreover, the liquid crystal display which was excellent in the display quality by which the substrate interval was equalized by this manufacture method when height was formed in the front face of a substrate 11 can be offered.
[0078] In this operation gestalt, although only the liquid crystal display for color displays was explained, this invention is applicable not only to this but the liquid crystal display for monochrome display.
[0079] The outline cross section of the reflected type liquid crystal display 3 of an internal dispersion method is shown in 3rd operation gestalt drawing 7 , and the structure and the manufacture method of this liquid crystal display are explained. In drawing 7 , the same sign is given to the same component as liquid crystal displays 1 and 2, and explanation is omitted.
[0080] In a liquid crystal display 3, much detailed irregularity is formed in substrate (bottom substrate) 61 front face, and the reflecting layer 66 which has much detailed irregularity is formed on a substrate 61 by carrying out sputtering of the metals, such as aluminum, along with detailed irregularity. On a reflecting layer 66, the insulating layer 67 which consists of a silicon dioxide for protecting a reflecting layer 66 etc. is formed, and the light-filter layer 18 and the transparent-electrode 20 grade are formed like liquid crystal displays 1 and 2 on the insulating layer 67.
[0081] When a substrate 61 is a glass substrate, the irregularity with substrate 61 detailed front face is formed of the frosting processing which **********s the front face of a glass substrate unevenly with a fluoric acid solution etc. Moreover, in the case of a substrate with a substrate 61 not only a glass substrate but general, the irregularity with substrate 61 detailed front face is formed by spraying a particle on the front face of a substrate 61 of the sandblasting processing which makes a front face uneven.
[0082] This detailed height of concavo-convex heights serves as for example, 0.5-0.8 [mum] grade. Moreover, detailed irregularity is formed only in the viewing area 50 in substrate 61 front face. On the other hand, a reflecting layer 66, an insulating layer 67, the light-filter layer 18, a protective layer 19, transparent electrodes 20 and 21, and the orientation films 22 and 23 are formed not only in the viewing area 50 but in the non-display field 51.
[0083] Although the irregularity with substrate 61 detailed front face is formed of frosting processing, sandblasting processing, etc., detailed irregularity is formed by deleting the substrate 61 original front face also in processing [ which ]. Therefore, as shown in drawing 7 , in substrate 61 front face, a level difference is formed between the portion in which detailed irregularity is formed, and the flat portion which is not formed, and this level difference serves as 1 [mum] grade. That is, substrate 61 front face in a viewing area 50 is formed in the low position from substrate 61 front face in the non-display field 51. As a result of forming a level difference in substrate 61 front face, a level difference is formed in the reflecting layer 66 formed on it, the light-filter layer 18, the orientation film 22, etc. as shown in drawing 7 .
[0084] In this operation gestalt, the spacers 65A and 65B with which diameters differ bordering on a level difference on a substrate 61 are arranged according to the thickness (cell **) of the liquid crystal layer 13. That is, in the substrate 61 top, spacer 65A doubled with cell ** in a viewing area is sprinkled, and spacer 65B with small 1[mum] grade

diameter is arranged in the non-display field 51 rather than spacer 65A doubled with cell ** in the non-display field 51.

[0085] Here, how to sprinkle two kinds of spacers 65A and 65B on a substrate 61 is explained. The spacer distribution solution C which distributed spacer 65A uniformly by predetermined concentration according to the ultrasonic wave etc. to the single solvent or two or more sorts of single mixed solvents which are chosen from water, chlorofluocarbon, isopropyl alcohol, ethanol, etc. is produced. The spacer distribution solution D is similarly produced about spacer 65B.
[0086] In the viewing area 50 on a substrate 61, as the 1st operation gestalt explained, the distributed solution C of spacer 65A is uniformly sprinkled using the ink-jet nozzle 30. Moreover, in the non-display field 51 on a substrate 61, the distributed solution D of spacer 65B is uniformly sprinkled using another ink-jet nozzle 30.
[0087] Moreover, in this operation gestalt, it is desirable to use the adhesion spacer with which the front face was coated with thermoplastics as spacers 65A and 65B. As the 1st operation gestalt explained, Spacers 65A and 65B are fixable on a substrate 61 by using an adhesion spacer as spacers 65A and 65B.
[0088] Since it becomes possible to control the position which sprinkles a spacer by sprinkling a spacer with the ink-jet method using the ink-jet nozzle 30 according to this operation gestalt, When height is formed on the surface of the substrate, it doubles with the thickness (cell **) of a liquid crystal layer. Takabe can sprinkle spacer 65A with a small diameter, spacer 65B with a large diameter can be sprinkled in the low section, and the manufacture method of a liquid crystal display that the substrate interval was equalized can be offered. Moreover, the liquid crystal display which was excellent in the display quality by which the substrate interval was equalized by this manufacture method when height was formed on the substrate can be offered.
[0089] In this operation gestalt, although spacer 65B with a small diameter was sprinkled to the non-display field 51, it is also possible by sprinkling spacer 65A only to a viewing area 50, and not sprinkling a spacer in the non-display field 51 to equalize a substrate interval. However, it is desirable to sprinkle spacer 65B with a small diameter in the non-display field 51 from the point that a substrate interval can be equalized.
[0090] Moreover, in this operation form, although only the liquid crystal display for color displays was explained, this invention is applicable not only to this but the liquid crystal display for monochrome display.
[0091] In addition, in the 1st - the 3rd operation form, although each was explained about the simple matrix type liquid crystal display, this invention cannot be limited to this, can be applied also to the active matrix type liquid crystal display using 3 terminal type element represented by 2 terminal type element represented by MIM (Metal-Insulator-Metal) and TFT (Thin-Film Transistor), and can be applied to any liquid crystal displays.
[0092] Moreover, the electronic equipment which was excellent in display quality can be offered by having the liquid crystal display offered by this invention.
[0093] Next, the example of electronic equipment equipped with either of the liquid crystal displays 1, 2, and 3 manufactured according to the aforementioned 1st - the aforementioned 3rd operation form is explained.
[0094] Drawing 8 (a) is the perspective diagram having shown an example of a cellular phone. In drawing 8 (a), 70 shows the main part of a cellular phone, and 71 shows the liquid crystal display section equipped with either of the aforementioned liquid crystal displays 1, 2, and 3.
[0095] Drawing 8 (b) is the perspective diagram having shown an example of carried type information processors, such as a word processor and a personal computer. In drawing 8 (b), the liquid crystal display section which 80 equipped with the information processor and 81 equipped with the input sections, such as a keyboard, or the liquid crystal displays 1, 2, and 3 of the above [ 83 / an information processing main part and 82 ] is shown.
[0096] Drawing 8 (c) is the perspective diagram having shown an example of wrist watch type electronic equipment. In drawing 8 (c), 90 shows the main part of a clock and 91 shows the liquid crystal display section equipped with either of the aforementioned liquid crystal displays 1, 2, and 3.
[0097] Drawing 8 (a) Since each electronic equipment shown in - (c) is equipped with either of the aforementioned liquid crystal displays 1, 2, and 3, it becomes what was excellent in display quality.
[0098]
[Effect of the Invention] Since the spraying position of a spacer and the spraying number are controllable by sprinkling a spacer with the ink-jet method using the ink-jet nozzle which can set up arbitrarily the regurgitation position and the number of times of the regurgitation of a drop which are breathed out according to this invention as explained above, the manufacture method of a liquid crystal display and the liquid crystal display with which the spraying density of a spacer could be equalized and the substrate interval was equalized and which were excellent in display quality can be offered.
[0099] Moreover, by sprinkling a spacer with an ink-jet method, a spacer is sprinkled with red by only the range of a blue coloring layer, and the range of a green coloring layer can be provided with the manufacture method of the good liquid crystal display of contrast and liquid crystal equipment which are not sprinkled.

[0100] Moreover, by sprinkling a spacer with an ink-jet method, when height is on a substrate, the spacer with which it is small to Takabe with a spacer and the large diameters in the low section differ according to the thickness (cell **) of a liquid crystal layer can be sprinkled, and the manufacture method of a liquid crystal display and liquid crystal display with which the substrate interval was equalized and which were excellent in display quality can be offered.
[0101] Moreover, the electronic equipment which was excellent in display quality can be offered by having the liquid crystal display offered by this invention.

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[Translation done.]

* NOTICES *



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DRAWINGS

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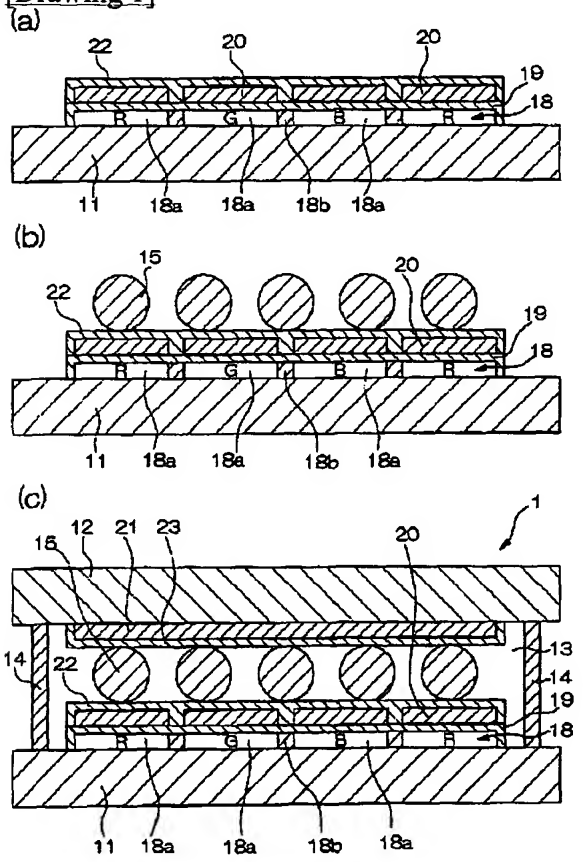
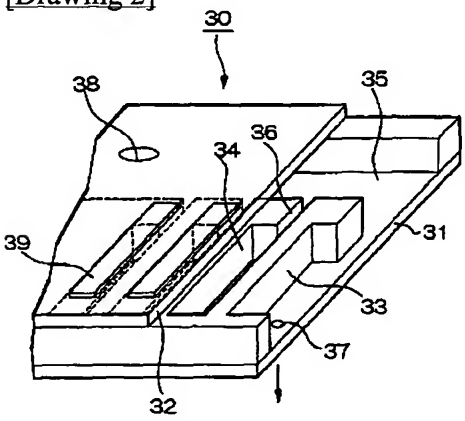
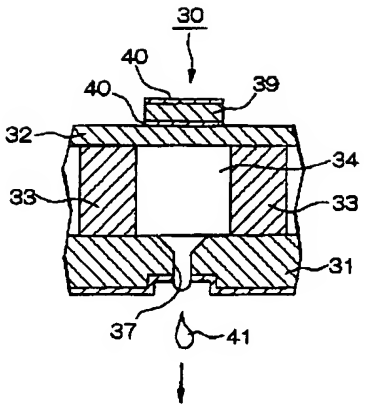
[Drawing 1]



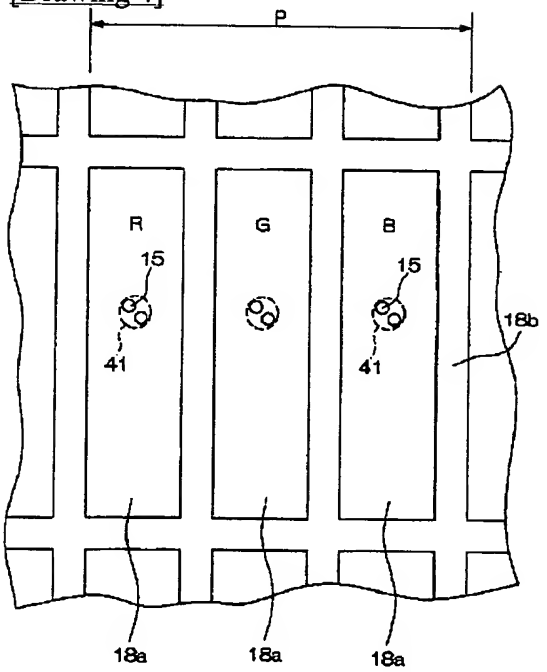

[Drawing 2]



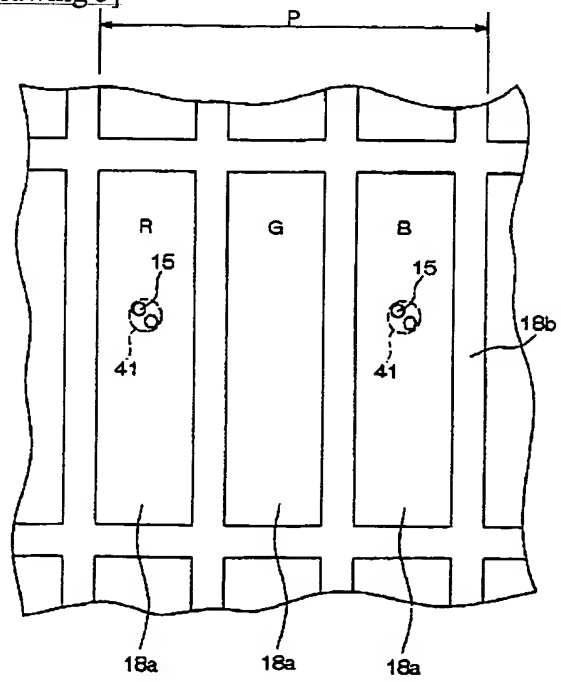

[Drawing 3]



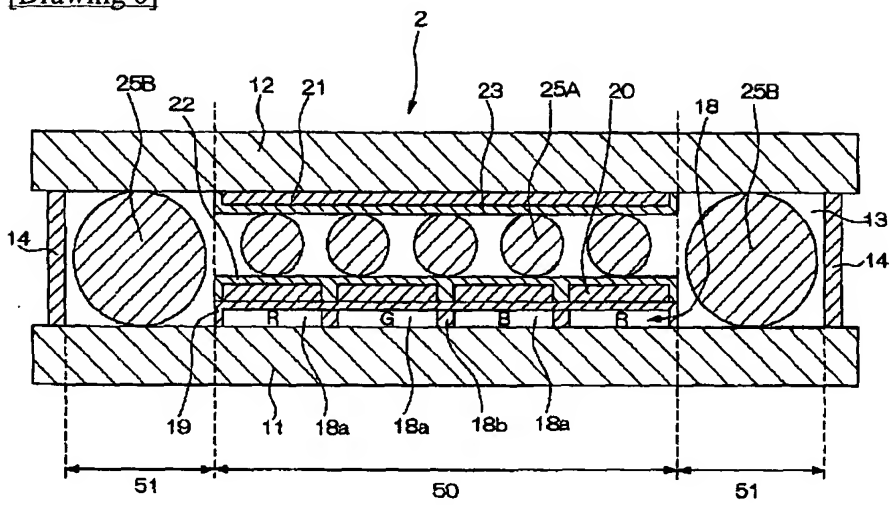

[Drawing 4]



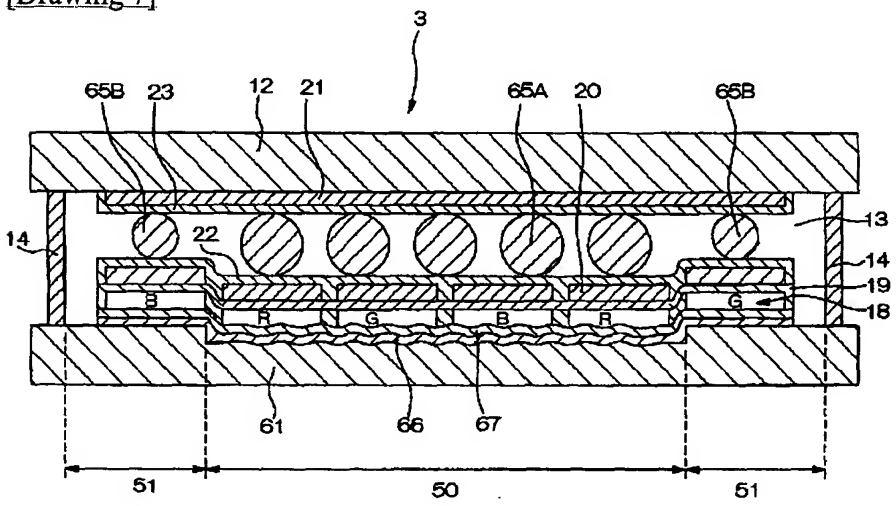

[Drawing 5]



[Drawing 6]

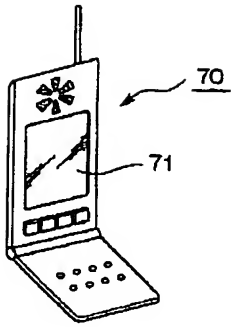



[Drawing 7]

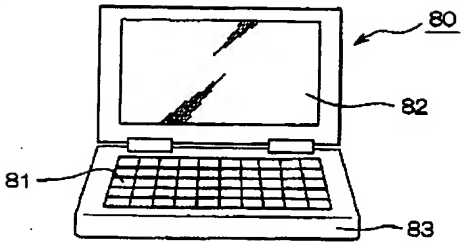



[Drawing 8]

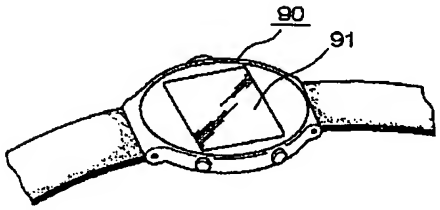
(a)



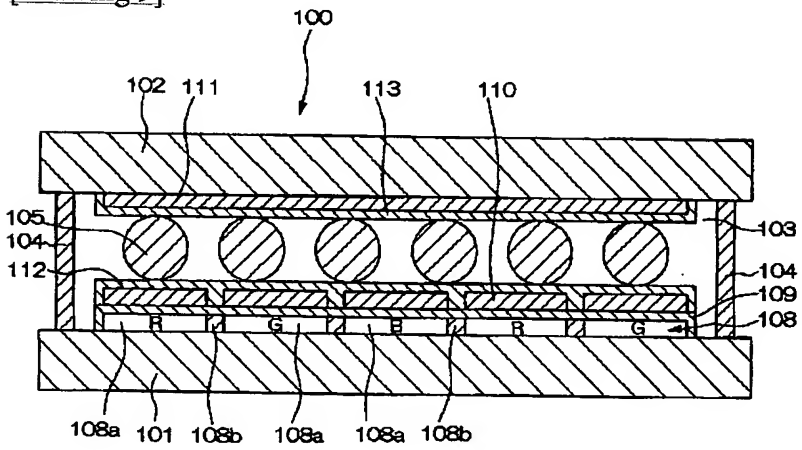

(b)




(c)

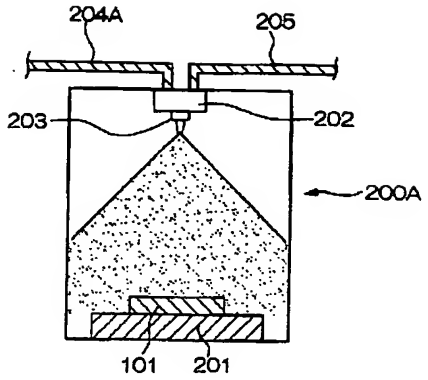



[Drawing 9]

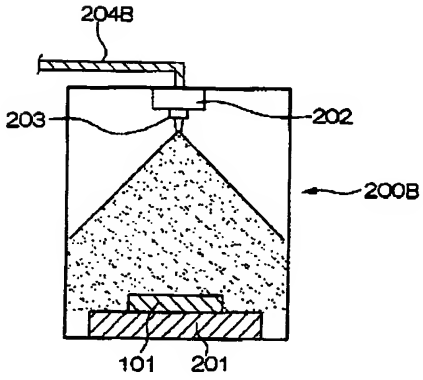



[Drawing 10]

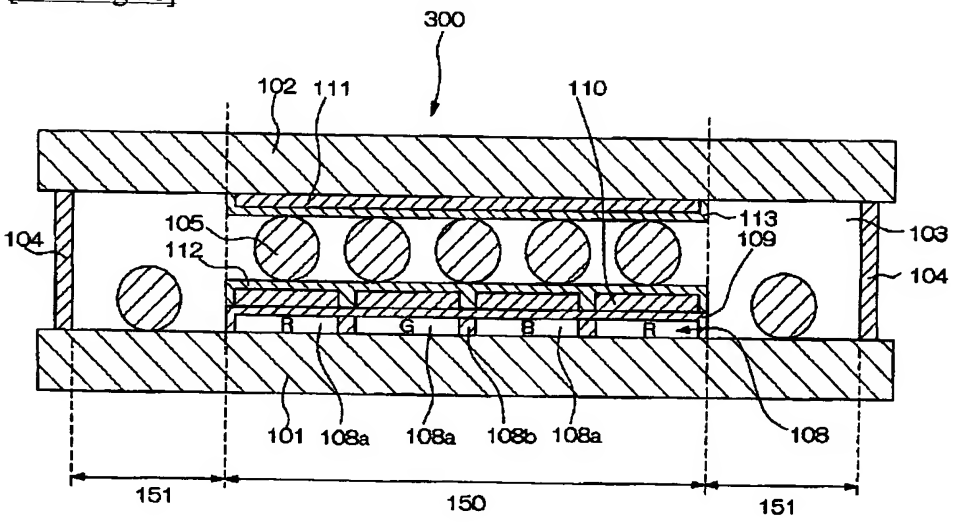
(a)



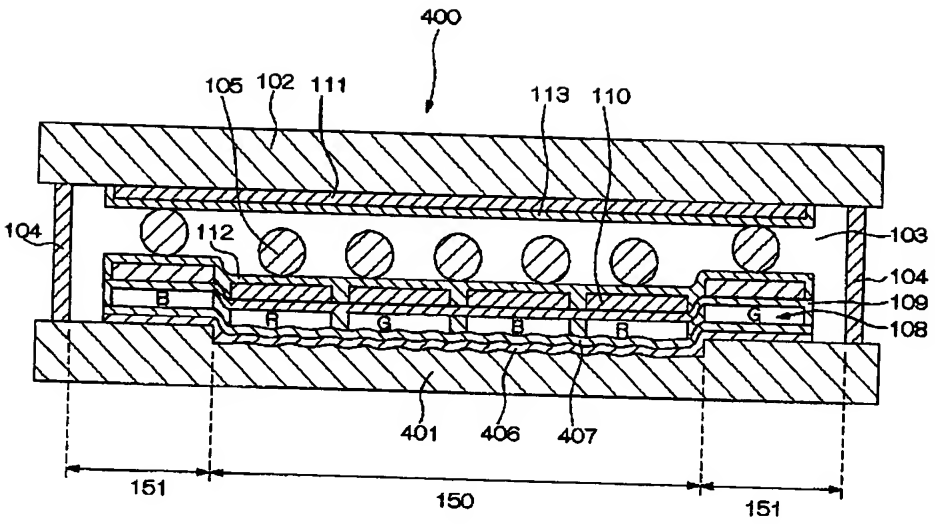

(b)




[Drawing 11]




[Drawing 12]




[Translation done.]